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(54) [Title of the Invention] Exposure apparatus and exposure  
method

(57) [Abstract]

[Object]

It is an object of the invention to provide exposure in  
which positioning of patterns is not needed and exposure  
facilitating to change a projection mask pattern.

[Constitution]

An exposure apparatus is constituted by a polarizing  
filter for controlling polarization of light generated from  
a light source and a polarizing filter for selecting a  
polarization component transmitted therethrough from a  
projecting mask and a projecting mask in which a pattern having  
different rotary polarization characteristics is present.

[Effect]

A plurality of patterns are present in one sheet of a  
mask, accurate positioning of the patterns can firmly be  
carried out, and also patterns of an projecting mask can easily

be formed.

[Claims]

[Claim 1]

An exposure apparatus characterized in an exposure apparatus comprising a light source and a projecting mask and a projecting lens for exposing a pattern on the projecting mask onto a wafer, wherein a polarizing filter for controlling a polarizing direction of light generated from the light source is provided between the light source and the projecting mask and a polarizing filter for controlling a polarizing direction of transmitted light from the projecting mask is provided between the projecting mask and the wafer.

[Claim 2]

The exposure apparatus according to Claim 1, characterized in that the projecting mask is constituted by a rotating polarization material having at least two or more of different rotary polarization characteristics.

[Claim 3]

The exposure apparatus according to Claim 1, characterized in that the projecting mask is constituted by a ferroelectric crystal.

[Claim 4]

The exposure apparatus according to Claim 1, characterized in that the two polarizing filters are provided with mechanisms for respectively rotating in a horizontal direction relative to the projecting mask.

[Claim 5]

The exposure apparatus according to Claim 1, characterized in that a coil for generating a magnetic field in a direction orthogonal to a direction of advancing light is provided between the two polarizing filters.

[Claim 6]

An exposure method characterized in an exposure method using a light source and a projecting mask and a projecting lens for exposing a pattern on the projecting mask onto a wafer, wherein a pattern in the projecting mask is projected onto the wafer by controlling a polarizing direction of light generated from the light source in a constant direction by a polarizing filter provided between the light source and the projecting mask and controlling a polarizing direction of transmitted light from the projecting mask by a polarizing filter provided between the projecting mask and the wafer.

[Claim 7]

The exposure method according to Claim 6, characterized in that the projecting mask constituted by a rotary polarization material having at least two or more of different rotary polarization characteristics is used in the above-described and a desired rotary polarization region in the above-described is selected by rotating the polarizing filter or by an intensity of a magnetic field generated from a coil provided between the polarizing filters to be exposed

onto the wafer.

[Claim 8]

The exposure method according to Claim 7, characterized in that pattern kinds having the different rotary polarization characteristics for the same wafer in the above-described are exposed onto the wafer by a plural number of times while selecting the pattern kinds by rotating the polarizing filter or by the intensity of the magnetic field generated from the coil provided between the polarizing filters.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application]

The present invention relates to an optical exposure apparatus and a method thereof. Particularly, the invention relates to an optical exposure apparatus used in fabricating a semiconductor element or the like and a method thereof.

[0002]

[Background Art]

An exposure apparatus of a background art is constituted by a light source and a projecting mask in which a light blocking pattern or a semitransparent film pattern is present and an optical lens. Further, an exposure method of a background art is a method of projecting a light blocking pattern or a semitransparent film pattern formed on a projecting mask onto a wafer by using the light source and the lens as in a reference

(Terasawa et al, Proc. of 1991 Intern. MicroProcess Conference pp.3-9).

[0003]

[Problems that the Invention is to Solve]

The exposure apparatus in the background art carries out exposure by projecting the light blocking pattern of the projecting mask onto the wafer. The light blocking pattern of the projecting mask is provided by working a metal film of chromium or the like or the semitransparent film constituted by a thin film of an oxide film or the like formed on transmitting glass. According to the exposure apparatus or the exposure method of such a mode, all of the light blocking pattern included in one sheet of the mask or phase shift pattern information is projected onto the wafer by one time exposure. Therefore, only one of pattern layer information is included in one sheet of the mask. Therefore, the mask needs to be prepared for each projecting mask and each pattern layer by one-to-one relationship. At this occasion, in fabricating one device, when a plurality of masks in correspondence with respective pattern layers are used, in order to accurately overlap patterns of the respective mask, the masks need to be positioned. In exposure of a small pattern of a semiconductor integrated circuit element or the like, highly accurate positioning is needed. Although in the background art, alignment marks are provided on the mask and the wafer for

positioning to adjust to position the marks before exposure, the adjustment is difficult and the highest accuracy in a current state is about 0.1 $\mu$ m. Further, according to the background art, the pattern at inside of the once fabricated projecting mask cannot be changed, and therefore, there poses a problem that the metal film or the like needs to be reworked or the like.

[0004]

It is an object of the invention to provide an exposure apparatus and an exposure method capable of forming a plurality of kinds of pattern kinds on the same wafer by one sheet of a mask with an excellent positional accuracy. Further, it is an object thereof to provide an exposure apparatus and an exposure method facilitating to change a shape of a pattern prepared at inside of a mask.

[0005]

[Means for Solving the Problems]

The above-described object is resolved by controlling polarization of light irradiated from a light source by rotating a polarizing filter (polarizer, detector) or by a magnetic rotary polarization effect (Faraday effect), or constituting a projecting mask by a rotary polarization material. Easiness in changing the pattern is resolved by using a ferroelectric material as a mask material.

[0006]



## [Operation]

According to the invention, two of polarizing filters are prepared to control to transmit only light having a certain specific polarizing direction. Light generated from a light source is normally provided with circularly polarized light. The light becomes light of linearly polarized light when the light passes through a first polarizing filter (polarizer). The light is irradiated to a projecting mask. The projecting mask is provided with at least two or more of regions having different rotary polarization characteristics. According to a material having a rotary polarization characteristic of quartz crystal, a ferroelectric body or the like, when light of linearly polarized light is transmitted therethrough, the light is emitted by rotating polarization thereof at inside of the material. An angle of polarization thereof differs by a kind of the material and a thickness thereof. Therefore, when the linearly polarized light transmits through the regions having the different rotary polarization characteristics, directions of rotating linearly polarized light or angles of rotating linearly polarized light differ from each other between the regions. That is, the light transmitting through the projecting mask is provided with the angles of polarization which differ for the respective pattern regions. Next, by a polarizing filter (detectorpolarizer), the rotation is matched to polarized light in the region in

correspondence with a desired pattern in the transmitting light. The polarizing filter transmits only a specific polarization component. Therefore, in order to transmit linearly polarized light through the filter, the linearly polarized light needs to be polarized light having the rotary polarization characteristic the same as that of the filter. By rotating the detector, only light of the region the angle of polarization of which coincides therewith transmits therethrough and light of the other region is absorbed by the detector. As a result, light transmits only through the pattern of the region having the polarization component selected by the detector and light of the other pattern region is blocked. Similarly, in selecting the projecting pattern, other than rotating the polarizing filter, polarized light rotation by a magnetic field (Faraday effect) may be applied. In this case, the rotating angle of polarization is proportional to the magnetic field, and therefore, the intensity of the magnetic field may be adjusted such that light of the region in correspondence with the desired pattern is transmitted. Further, according to the invention, a light blocking type pattern of the background art may naturally be used also in the same mask. In this case, the light blocking pattern region becomes the light blocking region regardless of polarization.

[0007]

When the projecting mask according to the invention constituted by patterning a rotary polarization material onto a transmitting mask of the background art is used as the projecting mask of the invention, or a ferroelectric crystal is used as a mask material, a twin structure having a different rotary polarization characteristic can easily be formed. A ferroelectric body is constituted by a material generally having rotary polarization characteristic. Particularly, the ferroelectric member having the twin structure at room temperature is excellent as the projecting mask constituting material since in respective twin regions, angles of rotary polarization are in directions opposed to each other. Further, formation of the pattern, that is, formation of a twin region in a case of using a ferroelectric crystal can be realized by directly irradiating an electron beam. According thereto, there is utilized a phenomenon in which when an electron beam is irradiated to a region constituting one crystal structure of a certain twin structure, the region is changing to other twin structure. By the method, reworking in changing the pattern can easily be carried out without using a complicated process of etching or the like.

[0008]

[Embodiment]

The embodiments of an exposure apparatus and an exposure method of the invention will be described.

[0009]

[embodiment 1]

First, an embodiment of the apparatus will be explained in reference to Figs.1, 3. Ultraviolet ray 2 generated by a mercury lamp 1 constituting a light source becomes parallel light by way of a lens 3 or condensed light to an incident pupil of a reduction lens 9. The light is a circularly polarized light ray. Next, only light polarized in a predetermined direction is transmitted through a filter face by a polarizing filter 4. The light is irradiated onto a mask 6. Inside of the mask includes a region (A pattern) 14 for rotating an angle of polarization by 0 degree for incident light and a region (B pattern) 15 for rotating the angle of polarization to the left by 5 degrees. Therefore, light transmitted through the mask is constituted by two polarizing components of the A pattern 14 rotated by 0 degree and the B pattern 15 rotated to the left by 5 degrees respectively for the incident light. The light rays are irradiated to a polarizing filter 7. First, an angle the same as that of the polarizing filter provided at an upper portion is set by a polarizing filter rotating mechanism 8. Then, transmitted light is constituted only by light of the A pattern, and the A pattern 14 reduced by the lens 9 is projected onto a wafer 10. Next, the angle of the polarizing filter 7 is rotated to the left by 5 degrees by the rotating mechanism 8. Then, at this time, only the B pattern

15 is transmitted therethrough and the B pattern 15 reduced by the lens 9 is projected onto the wafer. Further, the patterns may be selected by a polarizing filter rotating mechanism 5.

[0010]

[embodiment 2]

Here, an example of applying the invention to forming a pattern for ion implantation will be described in reference to Fig. 4. As the A pattern, the pattern 14 for high concentration implantation is prepared, and as the B pattern, the pattern 15 for low concentration implantation of Fig. 3 are prepared on one sheet of a mask 13. First, a silicon substrate is coated with a positive type polymer resist 17 by  $1\mu\text{m}$ . The substrate is set with an angle the same as that of the polarizing filter provided at the upper portion by the polarizing filter rotating mechanism 8. Then, only light of the A pattern 14 is constituted as transmitted light, and the A pattern 14 reduced by the lens 9 is projected onto the wafer such as transmitted light 16 of Fig. 4 (a). Next, the angle of the polarizing filter 7 is rotated to the left by 5 degrees by the rotating mechanism 8. Then, at this time, only the B pattern 15 is transmitted and the B pattern 15 reduced by the lens 9 is projected such as transmitted light 16 of Fig. 4 (b). At this occasion, a second exposure time period is reduced only to a predetermined amount of a first exposure time period by

adjusting the two exposure time periods. In a case that the substrate is developed, when a resist film thickness of a region in correspondence with the A pattern becomes 0, a resist film thickness of a region of the B pattern becomes, for example, 0.5 $\mu\text{m}$ . Next, ions are implanted as shown by Fig. 4 (c). An acceleration voltage is 50kV. Then, at the region of the resist film thickness of 1 $\mu\text{m}$ , boron ions 19 are hampered by the resist film 17, and therefore, the ions cannot reach a wafer 18. At the B pattern region, the resist film thickness is 0.5 $\mu\text{m}$ , and therefore, the boron ions 19 passing through the resist are implanted to the wafer. A depth of implantation of the region 21 is 50nm and a concentration of implantation is  $5 \times 10^{18}$  pieces/ $\text{m}^3$ . In contrast thereto, at the A pattern region, the resist film thickness is 0, and therefore, a depth of implantation of the region 20 is 150nm and a concentration of implantation is  $5 \times 10^{24}$  pieces/ $\text{m}^3$ . Positioning of A pattern 20 and B pattern 21 of Fig. 4 (d) is characterized in that an error is not brought about in positioning a center position since the same mask is unmovedly used by the exposure method. The step is characterized in that the concentration of implantation can be controlled to a desired value by arbitrarily controlling the resist film thickness since the exposure time period of the B pattern 16 can be adjusted independently from exposure of the A pattern.

[0011]

[embodiment 3]

Here, an embodiment of a method of forming a small gate electrode by using a similar exposure method will be described in reference to Figs. 2, 5. As the A pattern, the pattern 14 for an upper face of the gate of Fig. 3 is prepared on one sheet of the mask 13 and as the B pattern, the pattern 15 for a bottom face of the gate is prepared thereon. Quartz is made to constitute a mask material. First, a silicon substrate is coated with the positive type polymer resist 17 by  $1\mu\text{m}$ . For the substrate, a rotary polarization angle is made to be 0 by making a current of a magnetic coil 23 of Fig. 2 to be 0. Then, as transmitted light, only light of the A pattern is constituted, and the A pattern 14 reduced by the lens 9 is projected onto the wafer such as the transmitted light 16 (Fig. 5 (a)). Next, polarized light is rotated to the left by 5 degrees by generating a magnetic field 24 orthogonal to an optical path by making a current flow to the magnetic coil 23. In order to rotate polarized light in quartz by 5 degrees, a magnetic field of 3kOe is applied. Then, at this time, only the B pattern 15 is transmitted and the B pattern 15 reduced by the lens 9 is projected onto the wafer such as the transmitted light 16 (Fig. 5 (b)). At this occasion, a second exposure time period is prolonged more than a first exposure time period by a predetermined time period by adjusting the two exposure time periods. When the substrate is developed, in a case in which

a resist film thickness of a region in correspondence with the B pattern becomes 0, a resist film thickness of a region of the A pattern becomes, for example,  $0.5\mu\text{m}$  (Fig. 5 (c)). A dimension of a resist width of the resolved B pattern is  $0.1\mu\text{m}$ . Next, tungsten is deposited on the wafer by a vapor deposition method. When processed such that a maximum film thickness of tungsten becomes  $0.8\mu\text{m}$ , tungsten of a film thickness  $0.8\mu\text{m}$  is deposited on the B pattern brought into contact with a wafer face, and a film thickness at the A pattern region becomes  $0.3\mu\text{m}$  (Fig. 5 (d)). In a background art, machining is carried out by using 2 sheets of masks for twice exposure, and therefore, positioning accuracy of the A, B patterns is  $0.1\mu\text{m}$  at maximum and depending on cases, there is brought about a failure that positions of the A, B patterns do not overlap. In contrast thereto, also in the example, there is not a movement in switching masks, and therefore, a positioning error is always 0. By the process, an excellent gate having a small gate length and a small contact resistance with an upper face electrode can be machined.

[0012]

[embodiment 4]

Here, a structure of a projecting mask used in the invention and its fabricating method will be described.

[0013]

As a rotary polarization material for a projecting mask



of the invention, there is quartz crystal, a ferroelectric body, a rotary polarization solution, a liquid crystal or the like. Here, among these, quartz and a ferroelectric material which are the most practical will be explained. A rotary polarization angle when transmitted through a mask material depends on a characteristic and a thickness of a material. First, quartz crystal is made to constitute a mask material. When transmitted through quartz of 1mm for a wavelength 546nm, a rotary polarization angle is rotated by 25.54 degrees. Hence, first, a quartz crystal plate having a thickness of 5mm is prepared. Next, the A pattern is etched by using dry etching by  $\text{CF}_4$  gas such that rotary polarization angle becomes 0 degree. Next, by similarly etching B pattern such that the rotary polarization angle becomes 5 degrees to thereby provide the projecting mask 13 of Fig. 3. In this way, when the thickness of the mask member is changed, 2 kinds or more of patterns can be included therein.

[0014]

Next, a ferroelectric mask will be explained in reference to Fig. 6. Here, as mask members 33, 34, a single crystal of  $\text{LiNbO}_4$  is used.  $\text{LiNbO}_4$  single crystal is a ferroelectric body having a structure phase transition temperature at 1210°C. At room temperature, the single crystal is provided with a twin structure of a trigonal system, and rotary polarization angles relative to each other are in directions of right optical

rotation and left optical rotation inverse to each other, and therefore, patterns can be selected easily by a filter. Therefore, the pattern can be formed without depending on a mask thickness. In forming a pattern, first,  $\text{LiNbO}_4$  single crystal 33 is mounted on a transmitting mask substrate 32. A temperature of a total of the crystal is elevated to  $1210^\circ\text{C}$  to constitute the total of the crystal by a titanium iron ore structure. The step corresponds to erasing the mask. Thereafter, when the temperature is lowered to room temperature, the total becomes one structure of twin. Hence, when a bottom face of the wafer is grounded and an electron beam is irradiated, the region is subjected to transition to another twin structure. By the process, the projecting mask patterns 33, 34 can be fabricated. Further, as a method of erasing the mask pattern, other than the above-described temperature elevating method, by applying an electric field in a constant direction of the mask plate, all can be constituted by the same structure by utilizing a property of the ferroelectric body.

[0015]

Otherwise, as the mask member, a single crystal of  $\text{LaNbO}_4$  may be used.  $\text{LaNbO}_4$  single crystal is a ferroelectric body having a structure phase transition temperature at  $500^\circ\text{C}$  and also a strongly elastic body. The crystal is constituted by a twin structure of a monolithic system at room temperature

and rotary polarization angles of respective differ from each other by 10 degrees. Therefore, the pattern can be formed without depending on the mask thickness similar to the above-described. In forming the pattern, first, a temperature of a total of a crystal is elevated to 500°C, and the total of the crystal is constituted by a tetragonal system. The step corresponds to erasing the mask. Thereafter, when the temperature is lowered to room temperature, the total becomes one structure of twin. Hence, when a force is locally applied, or an electron beam is irradiated, the region is subjected to transition to another twin structure. At this occasion, a transition region between the two twin structures is provided with a width of about 1.5nm, and therefore, a pattern having a linewidth the same as that of an electron beam diameter (10nm) is produced. Therefore, a mask capable of sufficiently corresponding nanometer machining can be realized. In carrying out exposure by using the mask, the pattern is selected by rotating the polarizing filter 7 of Fig. 1 by 10 degrees or rotating rotary polarization by 10 degrees by the magnetic field generating coil 23 of Fig. 2. Further, as a method of erasing the mask, other than the above-described temperature elevating method, by applying a force in a direction of one side of the mask plate, all thereof can be constituted by the same structure by utilizing a property of a strongly elastic body. In  $\text{LaNbO}_4$  single crystal, by applying a force of  $5\text{kg/cm}^2$ ,

the mask pattern can be erased.

[0016]

[embodiment 5]

Here, an example of integrating the invention to a compound process apparatus will be explained in reference to Fig. 7. As an apparatus, the exposure apparatus of the invention is arranged at inside or right above a processing chamber 26. The processing chamber 26 is constituted by a heater 29 for high temperature process and a gas introducing portion 31, an ion irradiating portion 25, a vacuuming portion 30 and a high frequency generating apparatus. Exposure is carried out by using an ArF excimer laser 35 as a light source. First, the wafer 10 or a chip is mounted to the processing chamber, oxygen, steam gas are introduced by the gas introducing portion 31, thereafter, the temperature of the processing chamber is elevated by using the heater 29 for the high temperature process, and a thermally oxidized film is formed on the surface of the wafer by  $1\mu\text{m}$ . Next, the polarizing filter 4 or 7 is rotated by 5 degrees, and a pattern for forming an activation layer in the projection exposure mask is selected. Further,  $\text{CCl}_2\text{F}_2$  gas is introduced into the processing chamber from the gas introducing portion 31. Then, the excimer laser 2 is irradiated only to the pattern portion for forming the activation layer, and the oxide film is etched. The etching is carried out until completely eliminating the oxide film.

Next, the processing chamber is vacuumed from the vacuum exhaust portion 30 and boron ions are irradiated to an entire face of the wafer from the ion irradiating portion 25. Then, at a region having the oxide film, the boron ions are hampered in the oxide film, and therefore, only the pattern forming portion is implanted with the ions. Next,  $\text{CF}_4$  gas is introduced into the processing chamber from the gas introducing portion 31, a high frequency 27 is generated between an upper electrode 28 and the wafer 10, and a total of the oxide film is removed. Thereafter, the polarizing filter is rotated by 10 degrees, and the electrode forming pattern in the projection exposure mask 6 is selected. Further,  $\text{SiH}_4$  gas,  $\text{NF}_3$  gas, oxygen gas and the like are introduced to the processing chamber from the gas introducing portion 31. Then, the excimer laser 2 is irradiated only to the pattern portion for forming the electrode, and polycrystalpolycrystalline silicon is deposited. In this way, a semiconductor device is fabricated in the same processing chamber. Also in this case, machining having a pattern positioning error in twice exposure to be 0 and without using the resist can be carried out.

[0017]

[Advantage of the Invention]

According to the invention, a plurality of patterns are included in one sheet of a projecting mask, and therefore, exposure without using interlayer positioning can be carried

out. Further, the method is applicable to direct etching or deposition without using a resist of an excimer laser or the like, and therefore, the method can be applied to a compound process apparatus. Otherwise, the projecting mask used in the invention is easy to fabricate, erase and reproduce a pattern, and therefore, an inexpensive and efficient process can be carried out. Although in the embodiment, a solid crystal material is used as a rotary polarization substance, a similar effect is achieved even when a rotary polarization liquid is placed on the mask substrate or in the mask substrate. Further, according to the method of the invention, by setting a number of rotary polarization angles, a set number of pattern kinds can be included at inside of the projecting mask, and at a region common to the patterns, a light blocking pattern of the background art can also be used.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a view showing a constitution of an exposure apparatus according to an embodiment of the invention (part 1).

[Fig. 2]

Fig. 2 is a view showing a constitution of an exposure apparatus according to an embodiment of the invention (part 2).

[Fig. 3]

Fig. 3 is a view showing a constitution of a projecting mask according to an embodiment of the invention

[Fig. 4]

Fig. 4 illustrates views showing an ion implantation process according to an embodiment of the invention.

[Fig. 5]

Fig. 5 illustrates views showing an electrode forming process according to an embodiment of the invention.

[Fig. 6]

Fig. 6 is a view showing a ferroelectric projecting mask according to an embodiment of the invention.

[Fig. 7]

Fig. 7 is a view showing a compound process apparatus according to an embodiment of the invention.

[Description of Reference Numerals and Signs]

1..light source, 2..light, 3..lens, 4..polarizing filter, 5..rotary base, 6..projecting mask, 7..polarizing filter, 8..rotary base, 9..reduction lens, 10..wafer, 11..mask pattern, 12..projecting pattern, 13..mask substrate, 14..pattern A, 15..pattern B, 16..transmitted light, 17..resist, 18..wafer, 19..boron ion, 20, 21..ion implanting regions, 22..tungsten electrode, 23..magnetic field generating coil, 24..magnetic field, 25..ion generating source, 26..processing chamber, 27..high frequency generating power source, 28..upper electrode, 29..heater, 30..exhaust

portion, 31..gas introducing portion, 32..mask substrate,  
33..ferroelectric pattern A, 34..ferroelectric pattern B,  
35..excimer laser



[Drawings]

[Fig. 3]

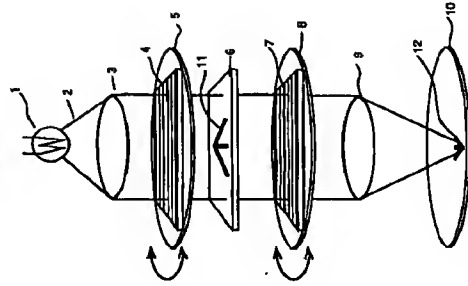
14..A pattern, 15..B pattern

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(54) [発明の名称] 露光装置および露光方法

(57) [要約]  
【目的】 パターン間の位置合わせの不用な露光と投影マスクパターンの変更の容易な露光を目的とする。  
【構成】 光源から発生される光の露光を制御する露光フィルタと投影マスクから透過した露光成分を選択する露光フィルタおよび露光フィルタを有したパターンを内蔵した投影マスクから構成される。  
【効果】 一枚のマスク内に複数のパターンを内蔵し、これらのパターン間の正確な位置決めが容易にでき、また投影マスクのパターン形成も容易にできる。

図1



【特許請求の範囲】  
【請求項1】 光源および投影マスクおよび投影レンズからなり投影マスク上のパターンをウェーハ上に露光する露光装置において、光源と投影マスクの間に光源から発せられる光の露光方向を制御する露光フィルタと投影マスクとウェーハの間に投影マスクからの透過光の露光方向を制御する露光フィルタを設けたことを特徴とする露光装置。  
【請求項2】 上記投影マスクが少なくとも二つ以上の異なる露光特性を有する透光性材料で構成されていることを特徴とする特許請求項1に記載の露光装置。  
【請求項3】 上記投影マスクが導電性絶縁体で構成されていることを特徴とする特許請求項1に記載の露光装置。  
【請求項4】 上記二つの露光フィルタが投影マスクに対してそれぞれ水平方向に回転する機構を設けたことを特徴とする特許請求項1に記載の露光装置。  
【請求項5】 上記二つの露光フィルタの間に光の進行方向に対して垂直方向に磁場を発生するコイルを設けたことを特徴とする特許請求項1に記載の露光装置。  
【請求項6】 光源および投影マスクおよび投影レンズを用い投影マスク上のパターンをウェーハ上に露光する露光方法において、光源と投影マスクの間に設けた露光フィルタにより光源から発生される光の露光方向を一定の方向に制御しまた投影マスクとウェーハの間に設けた露光フィルタにより投影マスクからの透過光の露光方向を制御することにより投影マスク内のパターンをウェーハ上に投影することを特徴とする露光方法。  
【請求項7】 上記において少なくとも二つ以上の異なる露光特性を有する透光性材料で構成された投影マスクを用い上記のうちの上記露光フィルタを上記露光フィルタを回転する露光装置を設けたことを特徴とする露光方法。  
【請求項8】 上記において同じウェーハに対して異なる露光特性を有するパターン層を上記露光フィルタの回転により露光フィルタの間に設けたコイルから発生する磁場の強さにより選択しながらウェーハ上に投影することにより露光することを特徴とする特許請求項7に記載の露光方法。  
【発明の詳細な説明】  
【0001】  
【産業上の利用分野】 本発明は、光學式の露光装置ならびにその方法に関する。特に、半導体素子の製造等に用いる光學式の露光装置ならびにその方法に係わる。  
【0002】  
【従来の技術】 従来の露光装置は光源と透光パターンあるいは半透明膜パターンを内蔵した投影マスクおよび光学レンズから構成される。また従来の露光方法は文獻に

erasawa et al, Proc. of 1991 Intern. MicroProcess C onference pp.3-9) のように投影マスク上に形成された透光パターンあるいは半透明膜パターンを上記光源およびレンズを用いてウェーハ上に投影する方法であった。  
【0003】  
【課題を解決しようとする課題】 従来の技術における露光装置は、投影マスクの透光パターンをウェーハ上に投影することによって露光を行っていた。この投影マスクの透光パターンは、透過ガラスの上に形成したクロム等の金属膜あるいは酸化膜等の薄膜による半透明膜加工して得られたものである。この様な形の露光装置あるいは露光方法では、一枚のマスクに含まれた透光パターンあるいは位相シフトパターン情報の全てが一回の露光でウェーハに投影される。従って、一枚のマスクには一つのパターン層情報しか含まれない。このため、投影マスクと各パターン層ごとにマスクを一枚一枚用意しなければならぬ。この際、一つのデバイスを作製するにあたり各パターン層に対応した複数のマスクを用いる場合には、それぞれマスクのパターンの値を合わせを正確に行うためにマスクの位置合わせが必要となる。半導体集積回路素子の微細なパターンを露光では、高精度の位置合わせが必要となる。従来はこの位置合わせのためにマスクとウェーハ上にそれぞれ合わせマークを設けてこれらのマーク間の位置合わせを露光前に調整していたが、その調整は困難で現状の最高精度は0.1μm程度である。また、従来の露光では一度作製した投影マスク内のパターンは変更できないので、上記金属膜等の加工をしないままにしなければならない等の問題があった。  
【0004】 本発明の目的は、一枚のマスクで複数のパターン層を同一ウェーハ上に位置精度良く形成できる露光装置及び露光方法を提供することにある。また、マスク内に用意されるパターン形状の変更の容易な露光装置および露光方法を提供することにある。  
【0005】  
【課題を解決するための手段】 上記目的は、光源から照射される光の露光を露光フィルタ（露光子、検光子）の回転あるいは磁気露光効果（フアラデー効果）により制御し、また透光性材料により投影マスクを構成することにより解決される。パターン変更の容易性はマスク材料として導電性材料を用いることで解決される。  
【0006】  
【作用】 本発明では、2つの露光フィルタを用意し、ある特定の露光方向を持った光だけを透過するよう制御する。光源から発生する光は通常円偏光を有している。最初の露光フィルタ（露光子）を通過すると偏光露光の光となる。この光を投影マスクに照射する。投影マスクは少なくとも二つ以上の露光特性の異なる領域を設けてある。水素や導電性材料の透光性のある材料では、露光の光が透過するときはその材料内で露光が回転して出てくる。その露光角は、材料の偏光及びその厚さによっ



[illegible]

**【0017】**

「脱脂の効果」本発明は、一般の脱脂マックスに複数のパターンが含有されているために周知と區別化するのに有用な特徴である。また、本発明は、エキシマーレーザー等の光による照明を必要とせず、エキシマーレーザーの適用が可能となる。また、本発明は、組合プロセス装置への応用が出来る。このため、本発明に用いる脱脂マックスは、タービン製、溶接および生産が容易であるので安価で効果的なプロセスが可能な材料である。本発明では、脆性金属として鋼材結晶材料を用いたが、脆性金属を透過性マックス基盤とあるいは、マックス基盤中に、脆性の効果が得られる。また、本発明の方法では、脆性を多数決定するので設定し

た分のパターン種を投影マスク内に内在させることが可能で、パターン間で共通する領域では、従来の遮光パターンを併用できる。

【図面の簡単な説明】

【図1】本発明の一実施例に係る露光装置の構成を示す図（その1）。

【図2】本発明の一実施例に係る露光装置の構成を示す図（その2）。

【図3】本発明の一実施例に係る投影マスクの構成を示す図。

【図4】本発明の一実施例に係るイオン打ち込みプロセスを示す図。

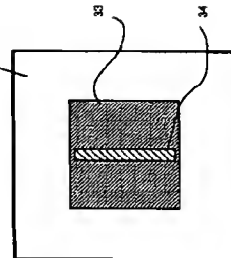
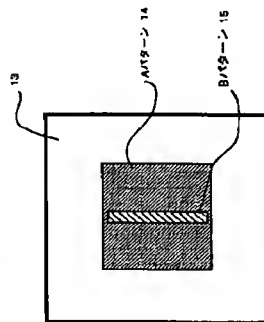
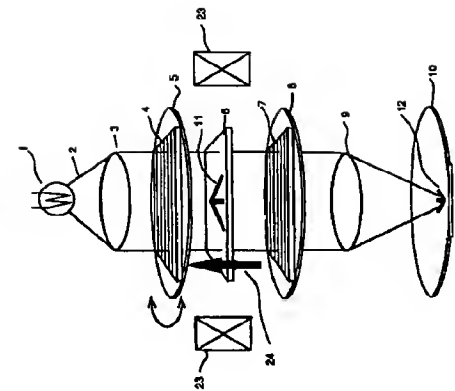
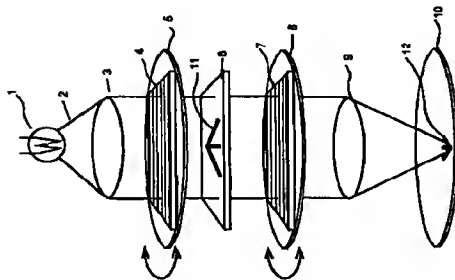
【図5】本発明の一実施例に係る電極形成プロセスを示す図。

【図5】本発明の一実施例に係る強制電圧投影マスクを示す図。

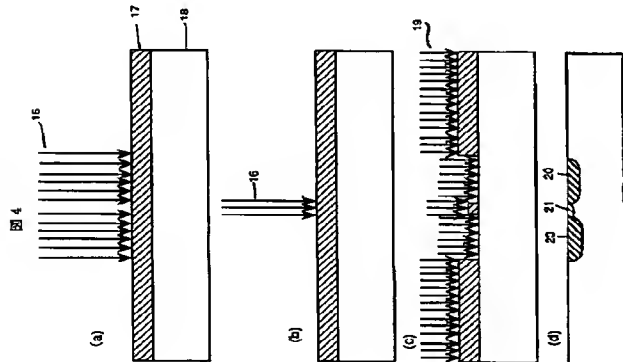
【図7】本発明の一実施例に係る複合プロセス装置を示す図。

【符号の説明】

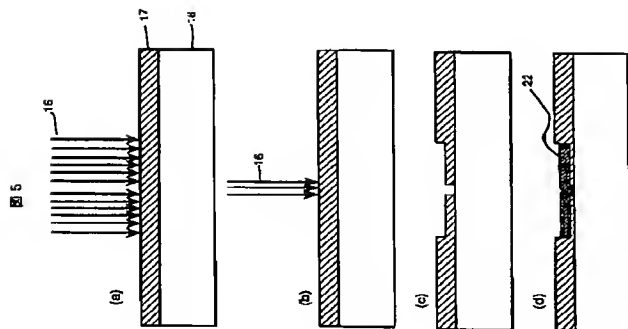
1・光源、2・光、3・レンズ、4・覆光フィルム、5  
 ・回音台、6・投影マスタ、7・遮光フィルム、8・回  
 転板、9・線小孔レンズ、10・ウエーハ、11・マスク  
 パターン、12・投影パターン、13・マスク基板、14・パター  
 ン、15・パターンB、16・透過光、17・レジスト、18・  
 ウエーハ、19・ウエーハステージ、20、21・オ  
 ートフォーカス装置、22・タンダラム電圧、23・磁場  
 発生コイル、24・磁場、25・オン発生電圧、26・  
 オン発生電流、27・高周波発生電源、28・上昇段  
 制御部、29・ヒータ、30・排気口、31・ガス導入配  
 管、32・マスク基板、33・導電性パターン、34・  
 絶縁層パターン、35・エキスパネラ。



【図4】



【図5】



【図7】

